

# Public Health Impacts from Pressure Loss Events – CDC/WaterRF Epidemiological Study Update

PNWS AWWA  
Eugene, OR  
May 7, 2014

Presented by: Melinda Friedman, P.E.  
Confluence Engineering Group, LLC



# Acknowledgements

## ■ Centers for Disease Control and Prevention

- Julia Gargano, PhD, Principal Investigator
- Vince Hill, PhD, P.E., Co-Investigator
- Elizabeth Adam, Study Coordinator

## ■ WaterRF

- Grace Jang

## ■ Pinellas County Utilities

- Marsha Pryor
- Fred Small

## ■ Project Advisory Committee

- Melinda Friedman, Confluence
- Dan Quintanar, Tuscon Water
- Jeff Swertfeger, Cincinnati Water
- Charlotte Smith, Charlotte Smith & Assoc.



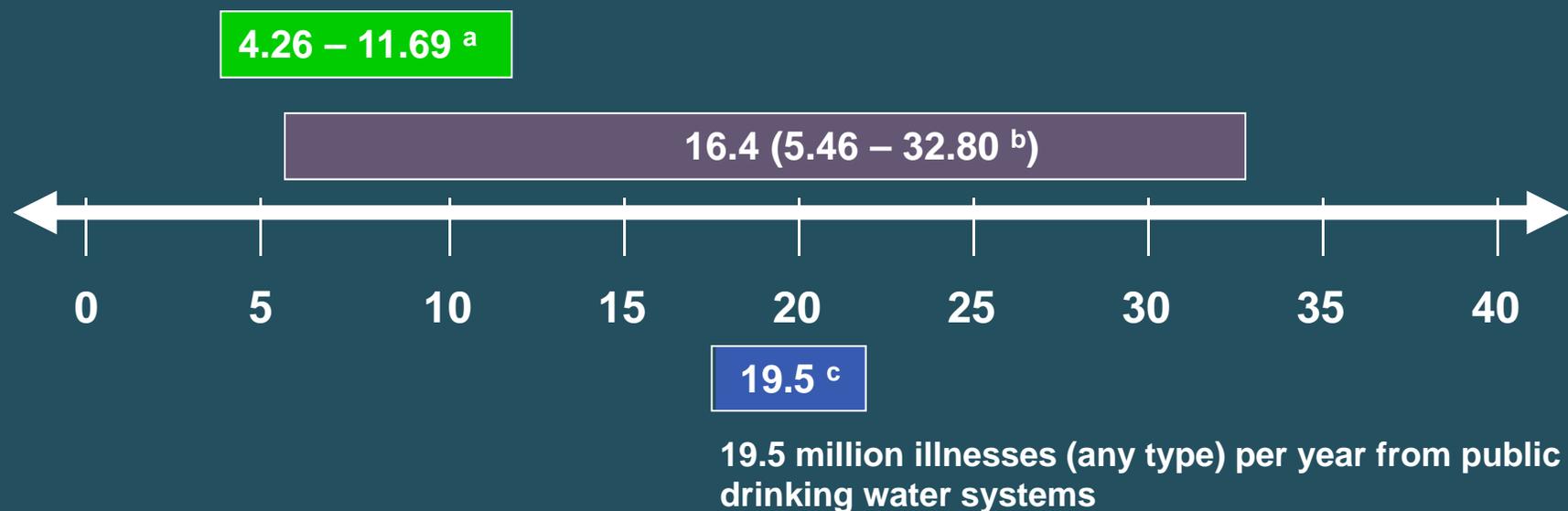
# Presentation Overview

- **Motivations for Study**
- **Overview of CDC Study Approach and Objectives**
- **Case Study**
- **Next Steps**



# Motivations for Study

# 4-32 million cases of acute gastrointestinal illness (AGI) per year from public drinking water systems



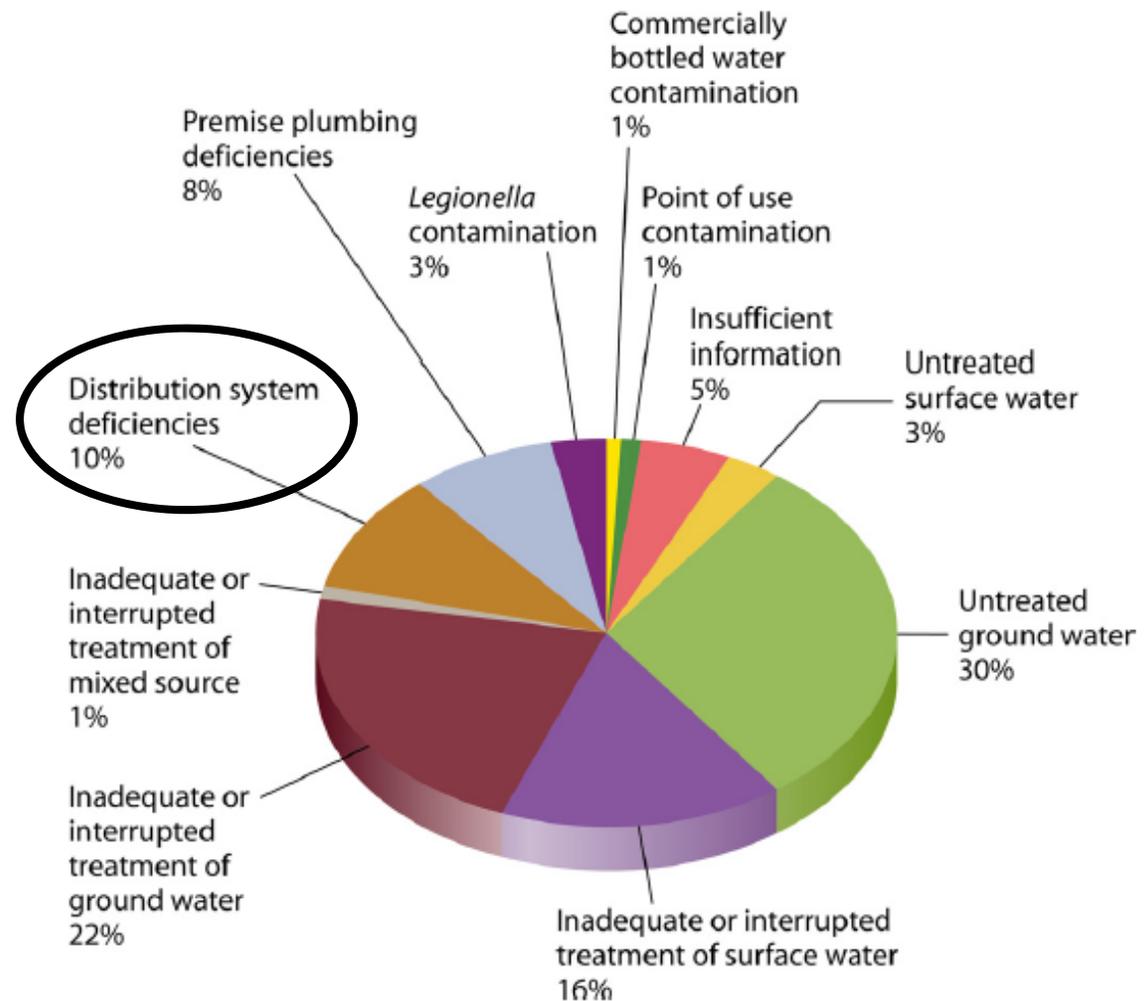
<sup>a</sup> Colford et al. Journal of Water and Health, 2006.

<sup>b</sup> Mesner et al. Journal of Water and Health, 2006.

<sup>c</sup> Reynolds et al., Rev Environ Contam Toxicol, 2008

# Distribution System Deficiencies Identified Through Outbreak Surveillance

- 10% of 780 drinking water outbreaks from 1971-2006\*
- Include storage, cross-connection, backflow, contamination of water mains during construction or repair



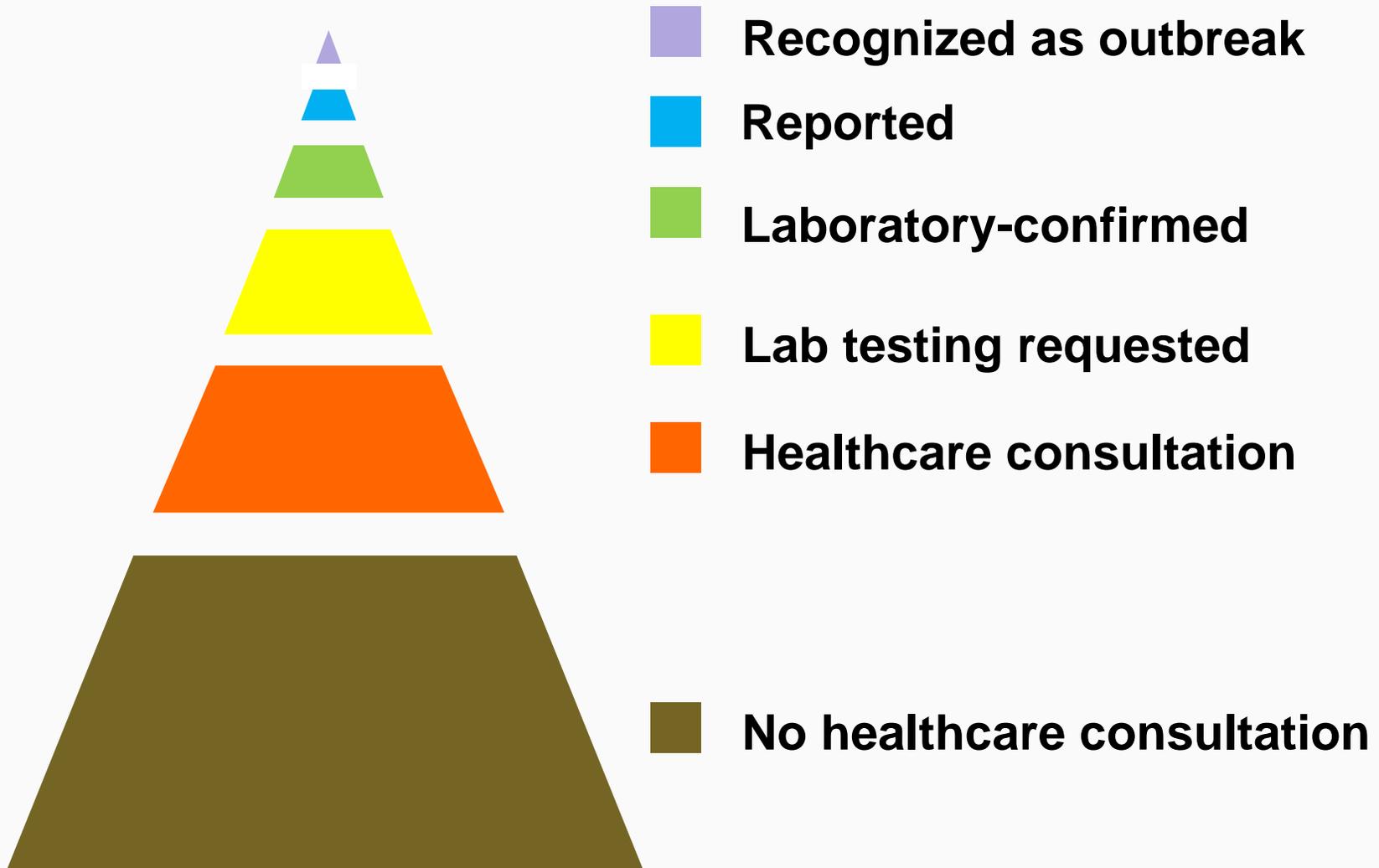
\*Craun, Brunkard et al 2009

# Limitations of Waterborne Outbreak Data

- **Important to note: Outbreak data are useful for identifying factors that contribute to outbreaks, but they aren't useful for quantifying the total burden of waterborne disease**



# Why Outbreak Surveillance Isn't Complete



# Norwegian Study Indicates that Main Breaks and Repair Events Pose a Public Health Risk

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Published by Oxford University Press on behalf of the International Epidemiological Association.

*International Journal of Epidemiology* 2007;36:873–880

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doi:10.1093/ije/dym029

## Breaks and maintenance work in the water distribution systems and gastrointestinal illness: a cohort study

Karin Nygård,<sup>1\*</sup> Erik Wahl,<sup>2</sup> Truls Krogh,<sup>3</sup> Odd Atle Tveit,<sup>4</sup> Erik Bøhleng,<sup>5</sup> Aage Tverdal<sup>6</sup> and Preben Aavitsland<sup>1</sup>

- ❑ Epidemiologic Study in Norway
  - ❑ 58% Higher risk for acute gastrointestinal illness (AGI)
  - ❑ No comparable data has been gathered in U.S.



# Research and Information Collection Partnership (USEPA/WaterRF)

- No current plans for a Distribution System Rule
- Rather, USEPA developed a Research and Information Collection Partnership (RICP)

## Objective:

To inform and support the drinking water community in developing future national risk management decisions pertaining to drinking water distribution systems

- Determine need for:
  - Regulation?
  - Guidance?
  - Revised Codes and/or Standards?
  - All or none of the above?



# Seven Research and Information Collection Priority Topics

## ■ Tier one:

- Cross-connections and backflow of contaminated water
- Contamination due to storage facility design, operation or maintenance
- Contamination due to main installation, repair or rehabilitation practices
- Contaminant intrusion due to pressure conditions and physical gaps in DS infrastructure

## ■ Tier two:

- Significance and control of biofilm and microbial growth
- Nitrification issues that lead to public health effects
- Accumulation and release of contaminants from DS scales and sediments



# Do Water Main Breaks and Repair Events Pose a Public Health Risk in U.S.?

- **Replicate Norwegian study<sup>1</sup> as national epidemiologic study in U.S.**
  - Water utility operation & regulation in U.S. different from Norway
  - Relevant U.S. health data important to inform possible future regulations
- **Water Research Foundation**
  - Agreed with study importance
  - Partnered with CDC



# Overview of CDC Study Objectives and Approach

# CDC Water and Health Study Objective



- ❑ **Determine whether individuals exposed to low pressure events (LPE) in the water distribution system are at an increased risk for acute gastrointestinal or respiratory illness.**

## Study Goals

- 1. Compare % of residents with symptoms of illness in the LPE area and in control non-LPE area.**
- 2. Compare distributions of microbial indicator levels between LPE and control areas.**
- 3. Describe LPE characteristics.**

# Study Design

- ❑ **Event-driven matched cohort study**
- ❑ **Select LPE area and matched non-LPE areas**
  - ❑ Match on pipe material and size, and drinking water source, housing type, demographics, census block or tract, etc.
- ❑ **Survey households from LPE and non-LPE areas**
  - ❑ Water use, recent water service, other activities
  - ❑ Illness symptoms in 1-3 weeks following date of event
- ❑ **Water samples from LPE and non-LPE areas**
  - ❑ Grab samples analyzed at utility lab and CDC
  - ❑ Ultrafilter (large-volume) samples analyzed at CDC
  - ❑ Suite of water quality indicators



# Method: Epidemiologic Cohort Study

1. Identify study households

Group of interest  
(in LPE area)



Comparison group  
(not in LPE area)



2. Wait 1 week,  
mail out surveys



3. Count who  
gets sick and  
compare

Group of interest  
(in LPE area)

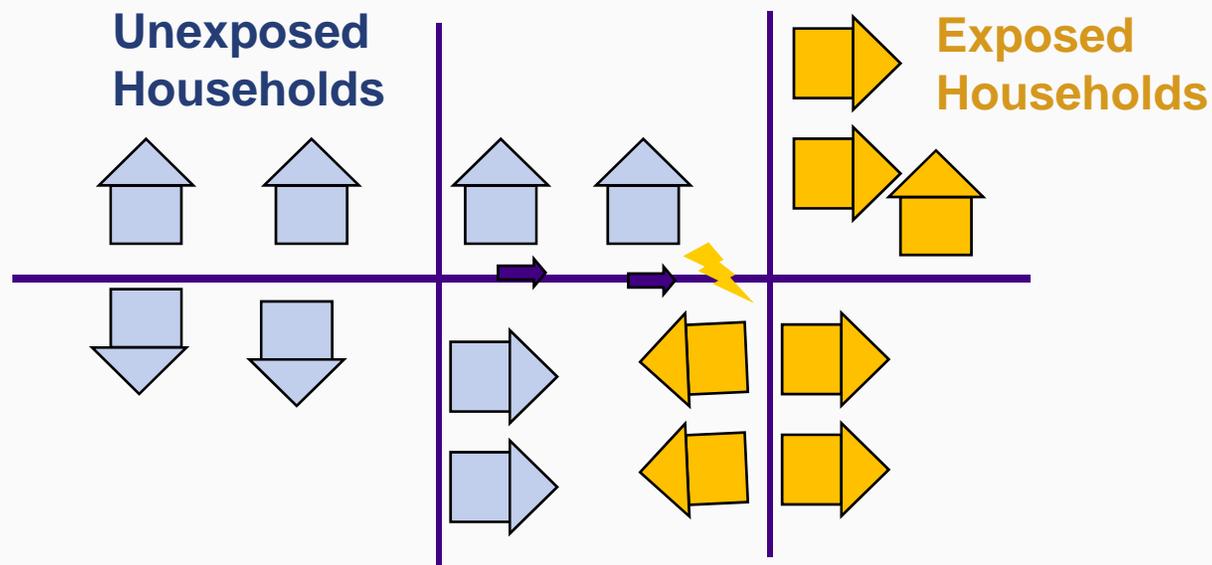


Comparison group  
(not in LPE area)



# Low Pressure Event Definition (LPE)

- **LPE: A water service disruption event or incident causing a presumed loss of water pressure in the distribution system.**
  - **Unplanned outages or planned maintenance events**



# Exposed vs. Unexposed Attributes

## Exposed Area Attributes

- Areas with known lower steady state pressures.
- Smaller diameter mains nearby or in direct hydraulic connection to LPE (upstream or downstream relative to normal flow direction).
- Higher elevation than main break location (assuming there is no nearby storage to compensate for the elevation).
- Near lower flow areas such as dead ends, pressure zone boundaries.
- Away from PRVs or storage facilities that float on the system, which would allow water to be released into the system to compensate for lower pressure caused by LPE.



# Exposed vs. Unexposed Attributes

## Unexposed Area Attributes

- Nearby but different pressure zone.
- No recent main breaks or LPEs in the vicinity.
- If in same pressure zone, downstream of storage facility that floats on system.
- If in same pressure zone, area served by larger diameter mains with routinely good steady state pressures.
- Areas in the middle of the grid (away from low flow sections, dead ends, pressure zone boundaries).



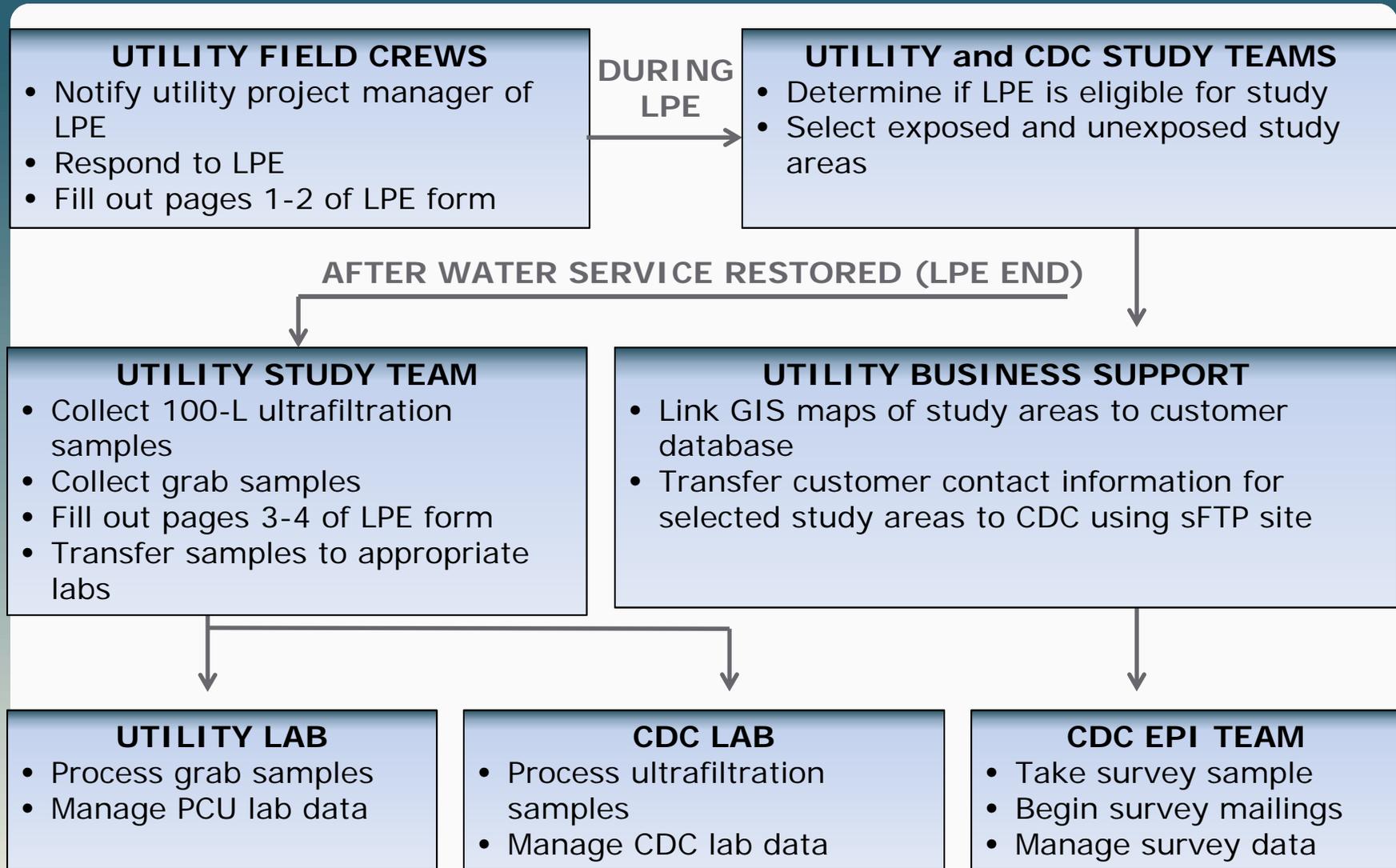
# Study Overview

- ❑ **Pilot – one utility**
  - Data collection for 6 LPEs
  - Completed field response March 2014
  
- ❑ **Pilot evaluation - CDC**
  - What can we improve?
  - Can we make it simpler?
  
- ❑ **Multi-site study – 4-5 utilities**
  - 65 LPEs (13 LPEs per utility, on average)
  - 6,700 household surveys
  - 390 water samples

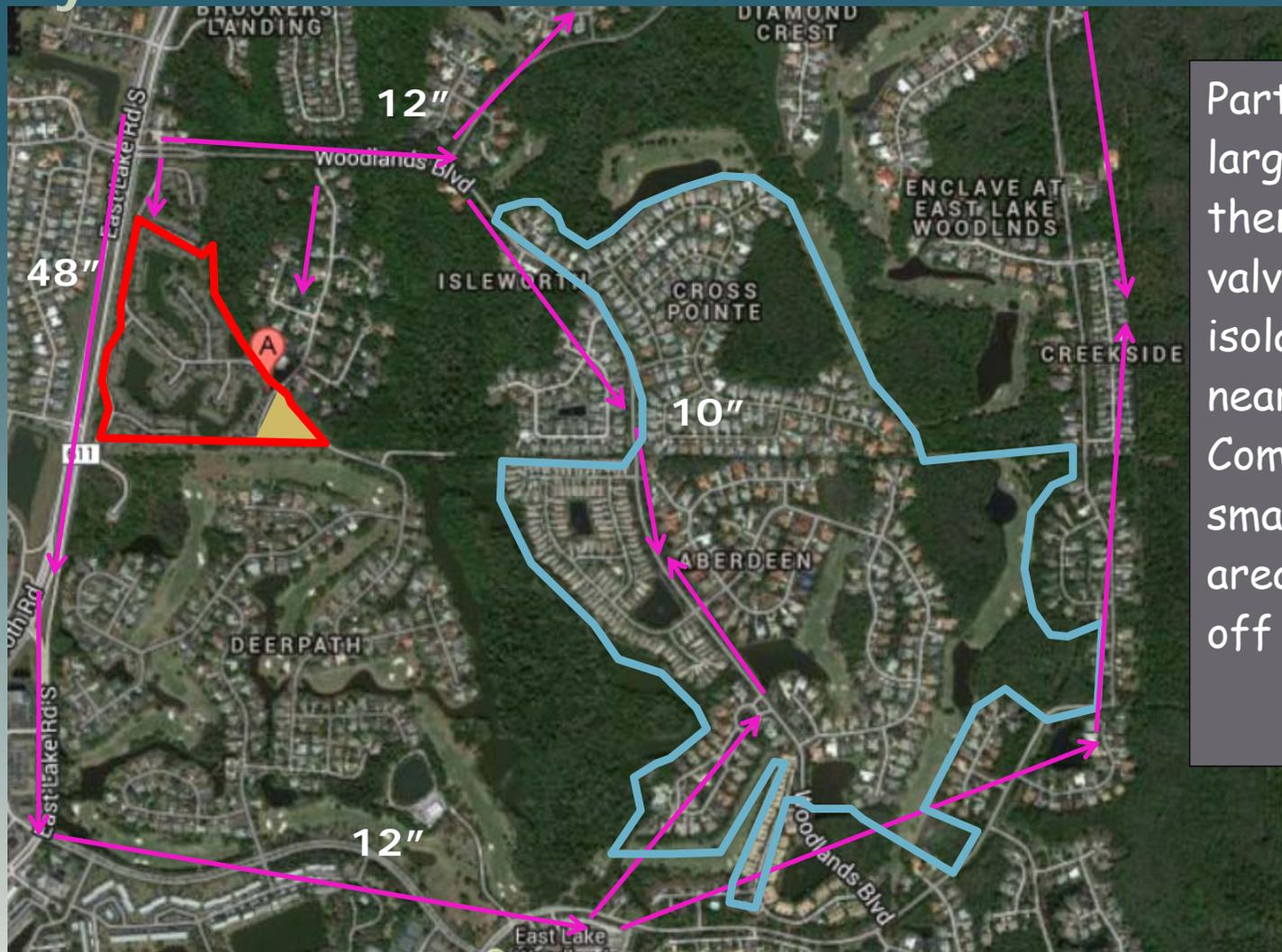


# Pilot Study

# Overview of Pilot Study Procedures



# Event 1: After-hours main break in looped portion of system

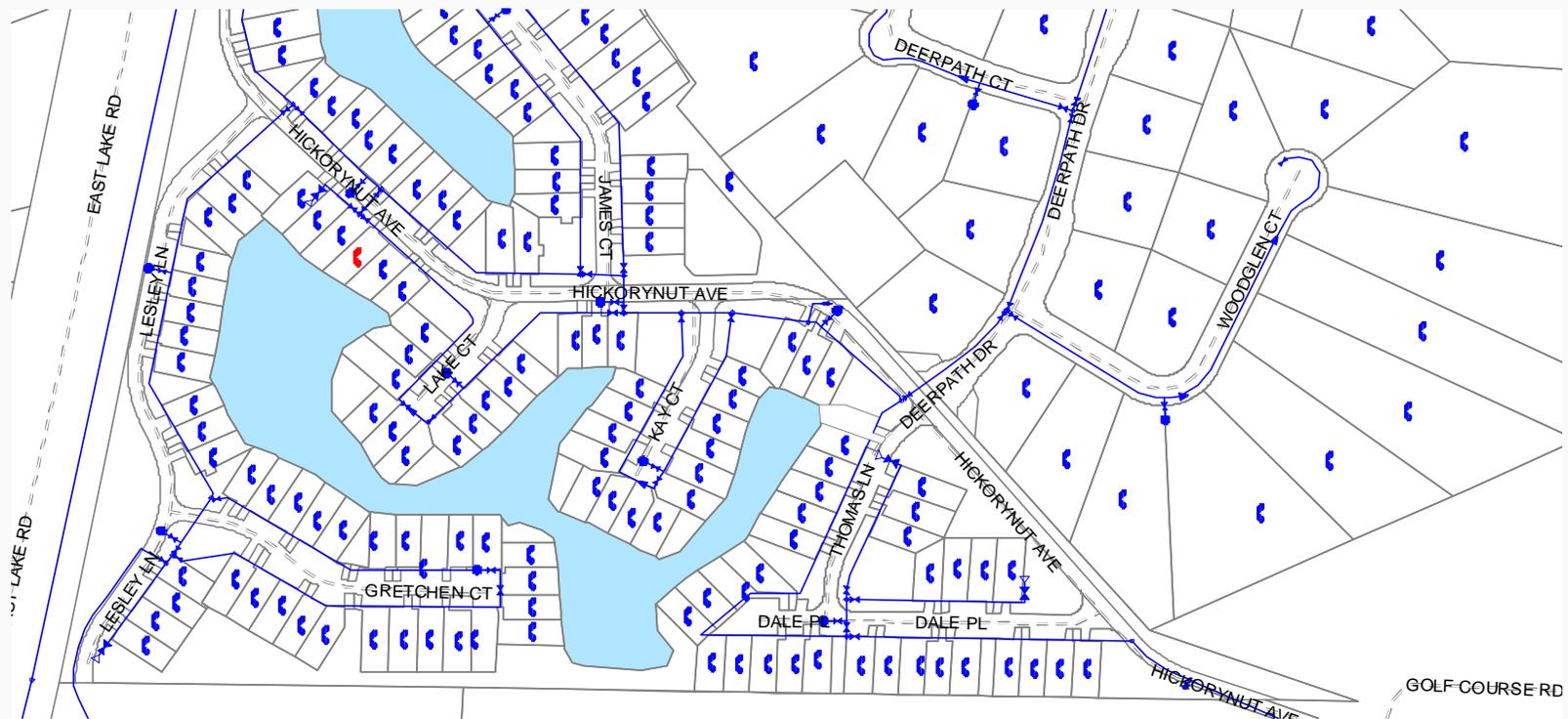


Partially shut-off larger red outline, then discovered a valve that could isolate smaller area near the break. Completely shut down small triangle. Entire area remained valved off for several hours.

- ➔ Normal flow direction
- "A" Break
- Exposed area outline
- Unexposed area outline

Source: CDC

# Identifying Customers in Exposed Area



# PCU Event 1: After-hours main break in looped portion of system

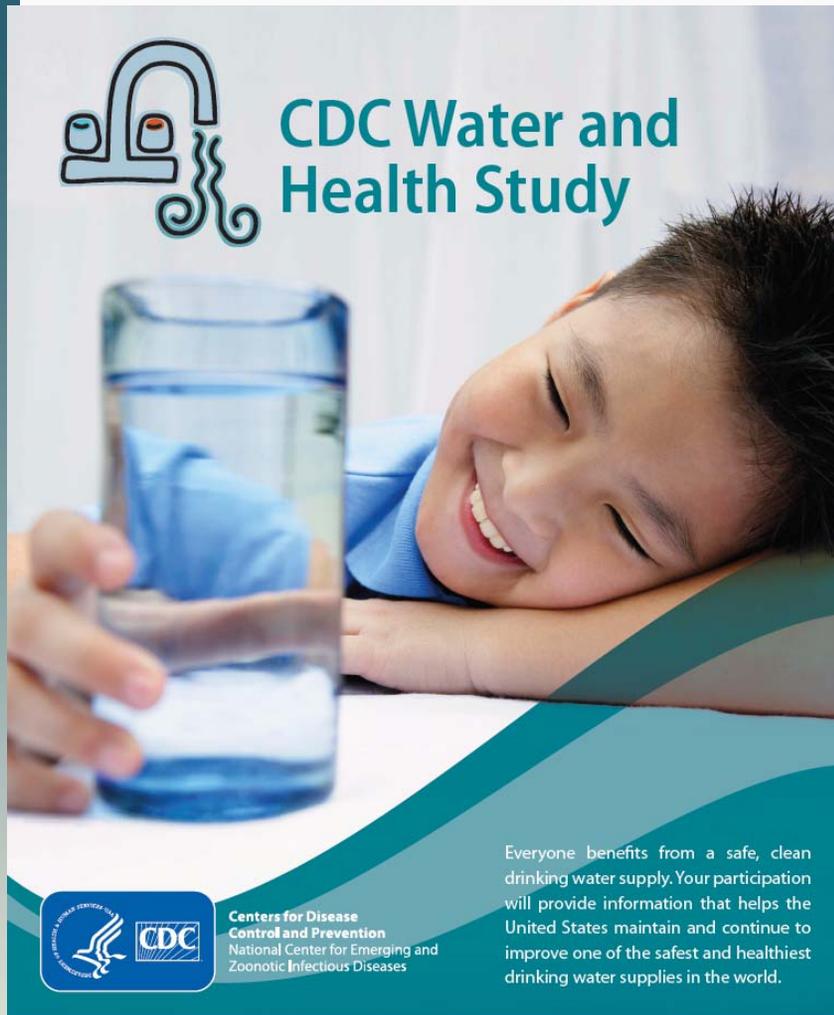
- ❑ **Used knowledge of system, hydraulics, and engineering attributes to define study areas**
- ❑ **Verified flow directions and choice of areas with hydraulic modeling**
  - Team assessment of areas and flow directions confirmed
- ❑ **Assessment of potential for contamination: High**
  - Muddy water got inside pipe during repair.
  - Water undermined tree and foundation of house.
  - Water created river down street and waterfall at break site.

## Communicating with the Public

- ❑ **Opportunity to show community that you are leaders in the field, proactively working to ensure the best water quality**
- ❑ **Press release, community outreach – CDC available to assist with communication**
- ❑ **Utility is volunteering to participate**
- ❑ **Study goal framed as understanding links between water use habits and health, not water quality**
- ❑ **Utility and customer results combined with others**
- ❑ **Utility not identified in publications**



# Survey Consent Brochure



The brochure cover features a stylized line-art icon of a faucet with water droplets on the left. The main title, "CDC Water and Health Study", is in a bold, teal font. Below the title is a photograph of a young boy in a blue shirt smiling and holding a glass of water. The bottom of the cover has a teal wave graphic. On the left, there is the CDC logo and the text "Centers for Disease Control and Prevention National Center for Emerging and Zoonotic Infectious Diseases". On the right, there is a paragraph of text.

## CDC Water and Health Study

Everyone benefits from a safe, clean drinking water supply. Your participation will provide information that helps the United States maintain and continue to improve one of the safest and healthiest drinking water supplies in the world.

 **Centers for Disease Control and Prevention**  
National Center for Emerging and Zoonotic Infectious Diseases

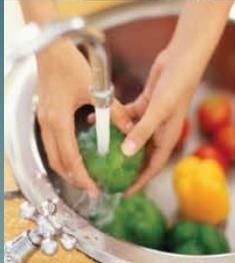
## To learn more about the CDC Water and Health Study or to ask questions about your participation:

- Visit the study website at <http://www.cdc.gov/healthywater/study.html>
- E-mail us at [waterhealthstudy@cdc.gov](mailto:waterhealthstudy@cdc.gov)
- Call us at 1-404-639-1700 (9:00 AM to 5:00 PM (EST) Monday–Friday)

The CDC Water and Health Study is a research project that will help us better understand the links between water use and health in communities across the United States. Your water utility has volunteered to work with the Centers for Disease Control and Prevention (CDC) on this study. Your participation can help us learn how to continue to maintain a safe, healthy water supply.



# Survey Consent Brochure



## What's the purpose of the CDC Water and Health Study?

U.S. tap water is one of the safest and healthiest drinking water supplies in the world. To keep it as safe and healthy as possible, we want to know how people use their tap water, and how water use affects health. The goal of this study is to understand water use and whether water use habits are linked to common illnesses. Your feedback will be combined with information from customers of other water utilities around the country. This information will be used to help make our water even safer.

## Why do you need me to participate?

We want to understand all the ways people in your community use their water, and everyone's experiences are important to the study. We'll be asking selected water utility customers across the country to participate in this research study over the next 2 years. Each and every household we invite is needed to give us the best understanding of everyone's experiences.

Even if you don't drink your tap water, your participation is still essential.

## What will my family and I have to do?

Participation is easy. Either fill out the paper survey booklet and mail it back to us in the provided postage-paid envelope, or log-on to the secure survey website link listed on your survey packet and fill it out on-line.

Up to 6 household members can take part in this study. If family members under the age of 18 would like to participate, we ask that an adult (someone who is at least 18 years old) fill out the survey on their behalf.

The survey should take less than 15 minutes.

## Why did you pick my community?

Several utilities from around the country have volunteered to work with the CDC on the Water and Health Study. By agreeing to be part of this study, your utility and its customers (like you) are providing an important contribution to public health.

We are selecting water systems that are typical of those found across the country. Being selected for the study does not mean that there is anything unusual about the water service in your community, and we will not be changing your water in any way as a part of this study.

## How will the CDC Water and Health Study benefit my family and other water utility customers?

Everyone benefits from a clean, safe, and healthy drinking water supply. Your participation will provide information to help the United States continue to maintain and keep improving one of the safest and healthiest drinking water supplies in the world.

## Are there drawbacks to my participation?

There are no known health risks associated with study participation.

## Will you keep my information private?

Yes. When the study is complete, your contact information will be removed from our files. No personal information about you will appear on any report. Survey responses will be treated in a secure manner and will not be disclosed, unless otherwise compelled by law.

## What if I choose not to participate?

There is no penalty if you decide not to participate. However, we hope that you will choose to participate in this important study.



# Study Website

CDC Home



Centers for Disease Control and Prevention  
CDC 24/7: Saving Lives. Protecting People.™

SEARCH

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## CDC Water and Health Study



[Email page link](#)

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### Contact Us:

Centers for Disease Control and Prevention  
1600 Clifton Rd  
Atlanta, GA 30333

800-CDC-INFO   
(800-232-4636)   
TTY:  
(888) 232-6348

[Contact CDC-INFO](#)

### Web-based Survey



**Click here to take the survey.** If you received a survey packet in the mail, you can log in here to complete the survey online. **Your username and password are located on the label on the front of your survey booklet.**

### On this Page

- [Frequently Asked Questions](#)
- [Contact Us](#)

The CDC Water and Health Study is a research project that will help public health researchers better understand the links between water use and health in communities across the United States. The study goal is to understand water use and whether water use habits are linked to common illnesses.

U.S. tap water is one of the safest and healthiest drinking water supplies in the world. To continue to maintain and improve our safe, healthy water supply, The Centers for Disease Control and Prevention (CDC) conducts research, develops programs, and implements projects designed to find links between community health and behavioral practices and water supply characteristics.

Over the next 2 years, selected water utility customers will be invited to participate in this study. Every person who participates helps answer important scientific questions - and makes sure that their community is represented in this national effort.

As a participant, you have a special opportunity to help lead the way in keeping our water supply clean, safe, and healthy!

## Frequently Asked Questions

# Next Steps

- **CDC is currently evaluating the success of the pilot (6 events at PCU)**
  - Assess if procedures allow team to meet study objectives
  - Needed modifications to streamline and/or improve process
- **Update methods, materials, and databases**
- **Resubmit for OMB approval**
- **Identify full-scale utility participants**
- **Launch multi-site study**



# Conclusions

- **Low pressure events are on the regulatory radar screen**
- **Important for utilities to use best management practices when dealing with LPEs**
- **Managers need to communicate importance to field crews**
- **Consider participating in multi-site CDC study!!!**

**Stay tuned...**



# Questions?

**Presented By:**

**Melinda Friedman, P.E.**

**Confluence Engineering Group, LLC**

**[melinda@confluence-engineering.com](mailto:melinda@confluence-engineering.com)**

**206.527.6832**

**[www.confluence-engineering.com](http://www.confluence-engineering.com)**

